Geostationary
Sea Surface Temperature
Product User Manual

METEOSAT (0°) SST (OSI-206)

GOES-E SST (OSI-207)

METEOSAT over Indian Ocean SST (demo)

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Prepared by

Document Change record

Document version	Software version	Date	Author	Change description
1.0		10/04/2011		First version.
1.1		02/05/2011		Minor correction : Table of content updated.
1.2		26/11/2011		Appendix A.1. updated
1.3		30/09/2013		Information concerning Surface Temperature over selected lakes added in the section 1.1. Other minor corrections and changes.
1.4		07/04/2016		Coefficients of Meteosat 10 SST algorithm and minor corrections
1.5		04/07/2016		Update of output formats and dissemination means
1.6	a1.0p1.0	13/07/2017		Addition of the demo product : METEOSAT over Indian Ocean SST Removal of information on GRIB (stopped since 12/01/2017)

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1. Introduction

1.1. Overview

The EUMETSAT Ocean and Sea Ice Satellite Application Facility (OSI SAF) is a consortium constituted of Météo-France as leading entity, and MET Norway, DMI, KNMI and Ifremer as co-operating entities.

The OSI SAF is routinely producing on a pre-operational or operational basis a range of air-sea interface products, namely: wind, sea ice characteristics, Sea Surface Temperatures (SST) and radiative fluxes : Downward Longwave Irradiance (DLI) and Surface Solar Irradiance (SSI).

OSI SAF commitments for a 5-years phase are described in the Product Requirement Document (PRD) [AD.1].
Operational and pre-operational OSI SAF products are described in the Service Specification Document (SeSp) [AD.2].
Validations statistics are provided in the Half-yearly Operations Reports and on the web site www.osi-saf.org.

Users are highly recommended to register on the OSI SAF Web Site : www.osi-saf.org, in order to get access to useful information, documentation and links, service messages, and to the helpdesk.

The main content of this manual are a description of the processing methods, an introduction to the algorithms used, some validation results and the product content and format.

The present manual describes the geostationary derived SST products.
The OSI SAF is committed to produce hourly SST products on distinct 0.05° resolution grids for GOES-E and MSG.
OSI SAF has no commitment on the hourly SST product with Meteosat-8 over Indian Ocean data which is available in a demo mode : these data are produced in "best effort" mode, and are not delivered under operational constraints. The production may be temporarily interrupted without any notice.

These three products include surface temperature over selected lakes, using the standard SST algorithms with no commitment on the accuracy and validation.

Table 1 describes the characteristics of the OSI SAF derived geostationary SST.

Name (reference)	Coverage	Resolution	Time characteristics	Formats	Timeliness	Volume per unit (NetCDF4)
MET SST (OSI-206)	60S-60N 60W-60E	0.05°	hourly	NetCDF L3C	4h	11-12 MB
GOES-E SST (OSI-207)	60S-60N 135W-15W	0.05°	hourly	NetCDF L3C	4h	3-11 MB
MET IO SST (demo)	60S-60N 19.5W-101.5E	0.05°	hourly	NetCDF L3C	4h	11-12 MB

Table 1: Characteristics of the OSI SAF geostationary derived SST products

L3C is the NetCDF format recommended by the Group for High Resolution Sea Surface Temperature (GHRSST). The L3C content is identical to L2P GHRSST products, “3” refers to gridded products and “C” to the fact that hourly products result from compositing 15 minutes (MSG) or 30 minutes (GOES-E) data.

The products are not available in GRIB format any more since 12/01/2017.

Validation are available in the following reports :

- Operational SST Retrieval from MSG/SEVIRI and GOES-E chain validation report [RD.1]
- Sea Surface Temperature over Indian Ocean from Meteosat-8 data, validation report [RD.2]

and demonstrate the positive impacts of the main updates introduced in 2011 in the geostationary chains: use of all radiometric data available, use of Numerical Weather Forecast profile derived bias correction.

1.2. Ownership and copyright of data

All intellectual property rights of the OSI SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge. If you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the words "Copyright © <YYYY> EUMETSAT" on each of the products used.

User feedback to the OSI SAF project team is highly valued. The comments we get from our users is important argumentation when defining development activities and updates. We welcome anyone to use the data and provide feedback.

1.3. Glossary

AATSR	Advanced Along Track Scanning Radiometer
AOD	Aerosol Optical Depth
Auxiliary data	Dynamic data that are used in the preparation of GHRSST L2P or L3 data products including wind speed, aerosol optical depth and sea ice.
AVHRR	Advanced Very High Resolution Radiometer
BT	Brightness temperature
CMS	Centre de Météorologie Spatiale (Météo-France)
DMI	Danish Meteorological Institute
ECMWF	European Centre for Medium-range Weather Forecasting
GDS	In situ and satellite data integration processing model
GHRSST	Group for High Resolution Sea Surface Temperature
GOES	Geostationary operational environmental satellite (US)
GRIB	GRIdded Binary format
L2	Levels from 0 to 4 have been defined by the remote sensing community to describe the processing level of products. Level 0 represents raw data, while Level 4 data have had the greatest amount of processing applied. Level 2 products are retrieved environmental variables at the same resolution and location as the level 1 source data.
L2P	Level 2 Pre-processed : On top of levels from L0 to L4 defined by the remote sensing community to describe the processing level of products, the SST community has developed a set of SST definitions in the context of the GHRSST. L2P products are satellite SST observations together with a measure of uncertainty for each observation in a common GHRSST netCDF format. Auxiliary fields are also provided for each pixel as dynamic flags to filter and help interpret the SST data. This family of data products provides the highest quality data obtained from a single sensor for a given processing window. In satellite projection.

L3C	Level 3 Collated : Gridding a single L2P file produces an "uncollated" L3 file (L3U). Multiple L2P files are gridded to produce either a "collated" L3 file (L3C) from a single sensor or a "super-collated" L3 file from multiple sensors (L3S). L3C products are gridded and resulting from compositing several orbits or slots from a single sensor.
MDB	Match up database
MET Norway	Norwegian Meteorological Institute
MF	Météo-France
MSG	METEOSAT second Generation
NAAPS	Navy Aerosol Analysis Prediction System
NetCDF	Network Common Data Form
NWP	Numerical Weather Prediction
PCV	Proximity confidence value
RDAC	Regional data assembly centre
Reference data	Pseudo static data and analysis products that are used by the GHRSST (e.g., climatology maps, previous SST analysis (T-1))
SDI	Saharan Dust Index
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SSES	Single Sensor Error Statistics
SST	Sea Surface Temperature
XML	Extensible Mark-up Language

Table 2: Glossary

1.4. Applicable and reference documents

1.4.1. Applicable documents

[AD.1] OSI SAF
CDOP 3 Product Requirement Document (PRD)
Version 1.0, April 2017

[AD.2] OSI SAF
Service Specification (SeSp)
Version 1.0, May 2017

Reference to an Applicable Document within the body of this document is indicated as reference in the list above, e.g. [AD.1].

1.4.2. Reference documents

[RD.1] OSI SAF
Operational SST Retrieval from MSG/SEVIRI and GOES-E upgraded chain validation report
SAF/OSI/CDOP/M-F/TEC/MA/183
Version 1.1, June 2011

[RD.2] OSI SAF
Sea Surface Temperature over Indian Ocean from METEOSAT-8 data, validation report
SAF/OSI/CDOP3/MF/SCI/RP/306
Version 1.0, 7 July 2017

[RD.3] GHRSST Science Team (2010)
The Recommended GHRSST Data Specification (GDS) 2.0
document revision 5 available from the GHRSST International Project Office, 2011, pp 123.
https://www.ghrsst.org/documents/q/category/ghrsst-data-processing-specification-gds/operational/

Reference to a Reference Document within the body of this document is indicated as reference in the list above, e.g. [RD.1].

2. Processing Chain

2.1. Overview

The OSI SAF geostationary SST chain includes the following main steps (see figure 1):

- preprocessing: Every frame of MSG/SEVIRI or GOES-E imager radiometric data (MSG: every 15 minutes; GOES-E: every 30 minutes) is ingested in full space resolution,
- cloud mask control,
- SST calculations,
- proximity confidence value determination.

The parameters used throughout the processing may evolve during the lifetime of the chain; the values indicated in this section are valid at the time of the present document.

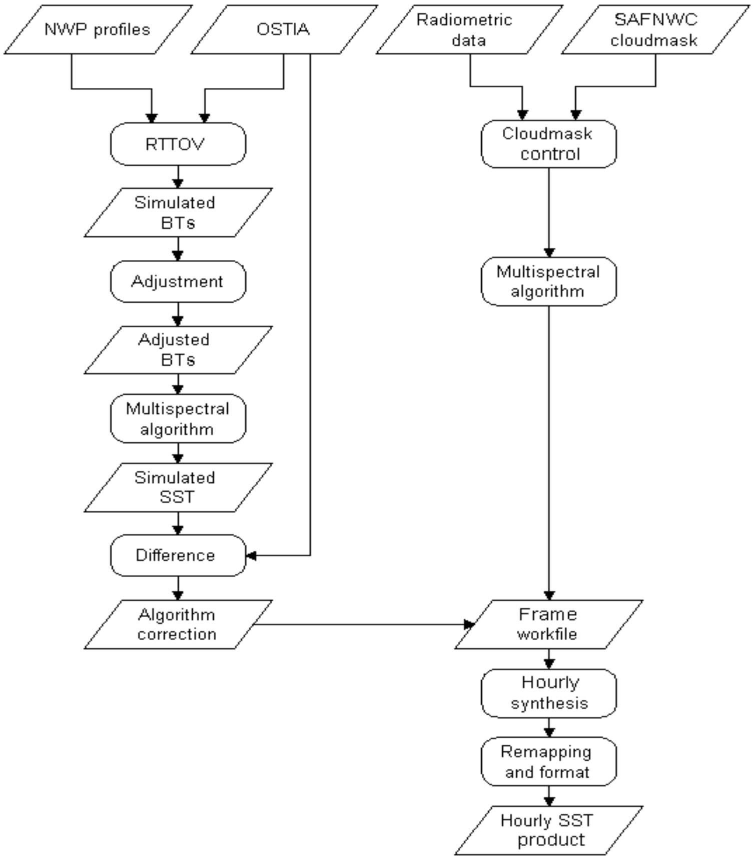


Figure 1: Overview of the geostationary chain. Radiometric data are used every 15’ (MSG) or 30’ (GOES-E). The algorithm correction is calculated every 3 hours and applied to the SST calculation the nearest in time.

Operational products are then produced by remapping over a 0.05° regular grid SST fields obtained by aggregating all SST data available in one hour time, the priority being given to the value the closest in time to the product nominal hour. Figure 2 shows an example of hourly MSG derived SST product from 60°S to 60°N and 60°W to 60°E (the SEVIRI regular grid); this figure shows also the GOES-E SST product produced by the same chain on a 0.05° grid from 60°S to 60°N and 135°W to 15°W . The present GOES-E platform (GOES-13) does not have a 12 micron channel enabling daytime SST calculations; GOES-E derived SST are restricted to nighttime conditions. The final products result from collecting data from various slots within one hour. Consequently they are considered as “L3C” (remapped collated) in the GHRSST product definition.

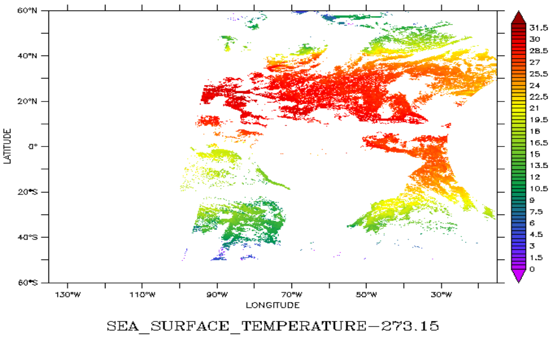


Figure 2: Geostationary chain SST products at 00:00 on the 10/09/2010; GOES-13 (with the most western part of the area masked due to daytime conditions)

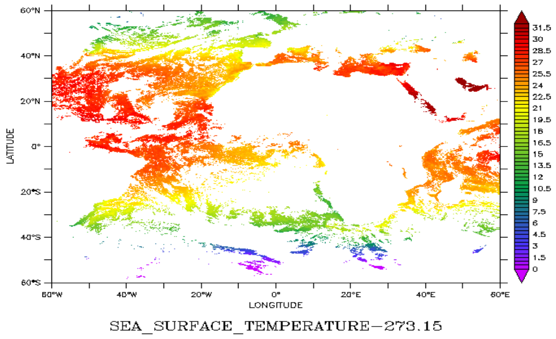


Figure 3: Geostationary chain SST products at 00:00 on the 10/09/2010; MSG

2.2. Preprocessing

The SST processing chain ingests the MSG or GOES-E radiometric data in full time and space resolution to which the NWC (Nowcasting) SAF cloud mask (Derrien and Le Gléau, 2005) is applied. It includes a clear/cloudy flag and quality information at the pixel level. A workfile including the radiometric brightness temperatures (BTs) or reflectances is built up in this step with all the further requested variables.

2.3. Cloud mask control

The NWC (Nowcasting) SAF cloud mask is controlled through a series of tests inspired from the METOP/AVHRR chain (LeBorgne et al, 2007). However, contrarily to the OSI SAF METOP/AVHRR chain, no addition is made to the original mask, in agreement with users requesting a maximal coverage by clear or mostly clear pixels. A series of tests has been defined that consider various quantities such as the local values of gradient, temperature, probability of ice, etc.. For each test, a test indicator has been defined by comparison of the tested quantity (test_value) with a limit value (limit_value) and a critical value (critical_value). Outside this range of values either there is no problem (test_value below limit_value), or the risk of errors is too high (test_value above critical_value). The test indicator is defined as:

$$\text{test\_indicator} = 100 \times (\text{test\_value} - \text{limit\_value}) / (\text{critical\_value} - \text{limit\_value}) \qquad (1)$$

Indicator values below 0, or above 100 are assigned to 0 and 100, respectively.

This approach enables the homogenization of the test results on a unique scale:

0: no problem;]0-100[: potential problem; 100: critical problem.

The mask_indicator is initialized (0 = clear, 100 = cloudy) from the NWC SAF flag values. After initialization, the value of mask_indicator is monitored for each clear water pixel (sea or lake).

- Primary cloud mask indicator: derived from the SAFNWC mask quality information available.

- Gradient indicator: This indicator is schematically based on the local value of the SST gradient, compared to the University of Rhode Island climatology of maximum SST gradients (Andersen & Belkin, 2006). Gradients are derived from a Sobel filter applied in 3x3 pixels boxes. The indicator is calculated by applying equation (1) where the test value is the local gradient, the critical value is the local climatologic maximum + 0.2K/km, the limit value is 0.03K/km, derived from the radiometer noise. In places where the climatology is missing, a value of 50 is assigned to the indicator.

- Time variability indicator: A fast drop in temperature may be indicative of cloud contamination. This is evaluated through the change in the 11 micron temperature in half an hour. The limit and critical values applied in equation (1) in this case are –0.5 and –1K (in half an hour) respectively.

- Stratospheric aerosol indicator: In case of need, this indicator will record the intensity of Pinatubo like stratospheric aerosol phenomena. It will be calculated according to (1), where the test value is the aerosol optical depth.

- Saharan dust indicator: It is based on the use of the SEVIRI derived Saharan Dust Index (SDI, see Merchant et al., 2006). The aerosol information in the NWC cloud mask or the NAAPS Aerosols Optical Depth (AOD, see US NAVY, 2003) are used in case the SDI information is not available. The limit and critical values applied in equation (1) in case SDI is used are 0.1 and 0.8 respectively. If the AOD is used (which may happen if the SDI is not calculated because one or more contributing channel(s) is missing as in the case of GOES-E), they are 0.1 and 0.3, respectively.

- Local temperature value indicator: The calculated SST is compared to limit and critical values of the temperature deduced from the Casey world SST climatology (see above), by adding margins to the local value of the minimum SST climatology. These margins are function of the interannual standard deviation of the temperatures, of the distance to the nearest cloud and of the distance to coast. Assuming a climatologic standard deviation of temperatures of 1K, the temperature limit and critical values in (1) are the climatologic minimum SST + 1.5K and –2K, respectively, in the most general case.

- Ice indicator: derived from the OSI SAF sea ice concentration product.

A synthesis of all the test indicators is made as the mean of all the meaningful test indicators. This mean value is the final value of the mask indicator. If an indicator is missing it is given a value =100 in the synthesis calculation. This mask indicator is used to reflect the quality of the mask in the SST quality level determination (see below).

2.4. SST calculation

2.4.1. Uncorrected SST

Two SST calculations are made: one in the context of cloud mask control, using the pixel values, and the final calculation using a smoothed atmospheric correction term over reliable data.

The operational SST algorithm used in day and night conditions for MSG/SEVIRI (at present Meteosat-8 and Meteosat-10) is the (non linear) NL algorithm described by the following equation:

$$SST = (a + b\, S_\theta)\; T_{11} + (c + d\, T_{CLI} + e\, S_\theta)\, (T_{11} - T_{12}) + f\, S_\theta + g \qquad (2)$$

where T_{11} and T_{12} are the BTs at 10.8 and 12.0 µm, respectively. TCLI is a climatological SST value.

For GOES-East (currently GOES-13) we use a T_{11} and T_{37} based algorithm described by equation (3):

$$SST = (a + b\, S_\theta)\; T_{11} + (c + d\, T_{CLI} + e\, S_\theta)\, (T_{3.7} - T_{11}) + f\, S_\theta + g \qquad (3)$$

Note that due to the lack of 12 micron channel in the GOES-E (GOES-13) imager, there are no SST in daytime conditions (see the western part of figure 2).

a, b, c, d, f and g are coefficients (see table 3) determined from brightness temperature simulations on a radiosonde profile database (Francois *et al.*, 2002), with the offset coefficient corrected relative to buoy measurements.

$S_\theta = \text{secant}(\theta_{sat}) - 1$; θ_{sat} is the satellite zenith angle.

A correction term derived from NWP profiles is then added to the multispectral derived SST (see next section).

Daytime is defined by the solar zenith angle being in the range 0 to 90 degrees and nighttime in the range 110 to 180 degrees. In twilight conditions (solar zenith angle from 90 to 110 degrees), the SST is calculated through a weighted mean of daytime and nighttime algorithms.

A Saharan Dust Index (SDI) correction term is calculated as a quadratic function of the SDI values (Merchant *et al.*, 2006), for 0<SDI<0.6. This correction depends on the algorithm used. No corrections are made when there is no SEVIRI observations. In these conditions there is a residual aerosol error that is flagged using the aerosol information in the NWC cloud mask or the NAAPS AOD. NB: The SDI is planned to be delivered as an experimental product, a dedicated document will describe its routine production.

At present the same algorithms are applied to retrieve surface temperature over sea and lakes.

	a	b	c	d	e	f	g
$NL_{meteosat08}$	0.98826	0.013554	0.0	0.853998	0.07293	0.332185	1.46651
$NL_{meteosat10}$	0.98946	0	0	1.08181	0.07022	0	1.66627
T37_4	1.03069	0.01123	1.19794	0.0	0.11748	2.79518	2.32694

Table 3: Coefficients of the non linear split window (NL) algorithms for METEOSAT_08 and METEOSAT_10, and dual window (T37_4) for GOES_13, respectively, with all temperatures expressed in Celsius.

2.4.2. Algorithm correction

Regional and seasonal biases have been detected in the SEVIRI derived SST fields by comparisons with drifter measurements (Merchant *et al*, 2009) and with SST estimates from sensors such as the Advanced Microwave Scanning Radiometer (AMSR-E) (Marullo et al, 2010) or the Advanced Along Track Scanning Radiometer (AATSR) (Le Borgne et al, 2011B). These biases are clearly due to limitations of the non linear (NL) split window algorithm.

CMS has been running a prototype chain since the beginning of 2009 for studying the combined use of SEVIRI BTs and the ECMWF forecast profiles to improve the SEVIRI derived SST calculations. A correction method has been defined (Le Borgne et al. 2011A), based on applying the operational algorithms to simulated brightness temperatures (BTs). Simulations are derived from applying the Radiative Transfer for TIROS Operational Vertical Sounder model version 9 (RTTOV-9, Saunders, 2008) to ECMWF profiles using a SST analysis (OSTIA, Donlon et al, 2011) as surface temperature. The correction is calculated as the difference between the retrieved SST from simulated BTs and the SST analysis used as input to the simulations.

In operational application, simulations should be done ideally for every MSG slot (resp. GOES-E) ; in practice BTs are simulated when model outputs are available (every 3 hours). Simulations are not perfect, due to model output errors, RTTOV errors and sampling of profiles. The adjustment of simulated to observed BTs is thus a critical step of the method. We have adopted an empirical approach based on averaging the simulated – observed BT differences over 20 day preceding the day being processed.

The main steps of the operational processing are :

- **Every 3 hours** (model output times):
  - Re mapping of ECMWF profiles and OSTIA SST onto the MSG (respectively GOES-E) spaceview grid; this step includes a bilinear interpolation to avoid a box effect due to resolution discrepancies,
  - Application of RTTOV at full space view resolution to simulate T39, T87, T108, T120 (MSG) and T39, T107 (GOES-E).
- **Every day at the round hour the closest to local midnight and corresponding to a model output time** (00:00 for MSG, 03:00 pour GOES-E ; this hour has been preferred to 06 :00 as suggested by the sub-point longitude due to the asymmetry of the GOES Ocean coverage) :
  - Calculation of the simulated –observed difference for strictly clear sky conditions (cloud mask indicator below 20),
  - Averaging of these differences over 20 days, smoothing (12*12 box) and interpolation to fill up the cloud induced gaps. This field is used during the next 24 hours to adjust the simulated BTs.
- **Every 3 hours** (model output time) :
  - Application of the current algorithms to the adjusted simulated BTs, calculation of the algorithm corrections.
- **Every slots** :
  - Application of the algorithm correction the closest in time: to mitigate the risk of excessive corrections (induced for instance by a misfit between the actual and predicted water vapour distribution) the correction must remain between cormin and cormax (= 2K at present).
  - calculation of an algorithm correction risk indicator as algo_correction_indicator= 100 cor/cormax ou = 100 cor/cormin, according to the sign of cor

2.5. Quality level determination

We must adopt a method similar to or compatible with those of our partners in the GHRSST. For IR derived products, the normalized quality level scale shows 6 values **A quality level is provided at pixel level, with increasing reliability from 2 (=”bad”) to 5 (=”excellent”); 0 means unprocessed and 1 means cloudy**. Quality levels are dedicated on one hand to give the user a simple mean of filtering the data and on the other hand to partition the MDB in view of deriving the sensor specific error statistics (SSES) which are delivered for every SST calculation in the L2P/L3 format. Pixels considered as dubious after the cloud mask control are labeled “bad”, whereas in the Metop/AVHRR chain they where labeled “cloudy”. **Users are recommended to use quality levels 3 to 5 for quantitative applications.**

In practice, quality levels are derived from the mask_indicator (see section 2.3), the algorithm correction indicator (see section 2.4) and the satellite zenith angle converted in indicator value on scale from 0 to 100. Each indicator (ind) is converted in quality level through the following scaling (see also table 3):

0<ind< A: level 5; A<ind<B: level 4; B<ind<C: level 3; C< ind: level 2.

Note that a critical value (> 100) of any of the test indicator in the cloud mask control step leads to attribute a level 2 to the pixel in question.

	A	B	C
Mask indicator	10	16	26
Algorithm risk indicator	20	50	100
Sat. zenith angle	80 (60 degrees)	87 (65 degrees)	93 (70 degrees)

Table 4: Thresholds used to convert indicators in quality levels

The final quality level is the lowest of the quality level value derived from each indicator. The thresholds in table 4 have been determined so that the mask indicator drives mainly the attribution of the quality level, the algorithm risk indicator and the satellite zenith angle degrading the levels in case they reveal a serious problem.

2.6. Product processing

At the end of the processing a workfile in NetCDF is filled up for each frame and contains:

- location and illumination conditions
- reflectances and brightness temperatures
- NWC cloud mask original information
- static data (landmask, climatology values,..)
- dynamic data (SEVIRI SDI, NAAPS AOD,..)
- intermediate calculation values (gradients, indicators..)
- final results (SST, missing reasons, PCV,..)

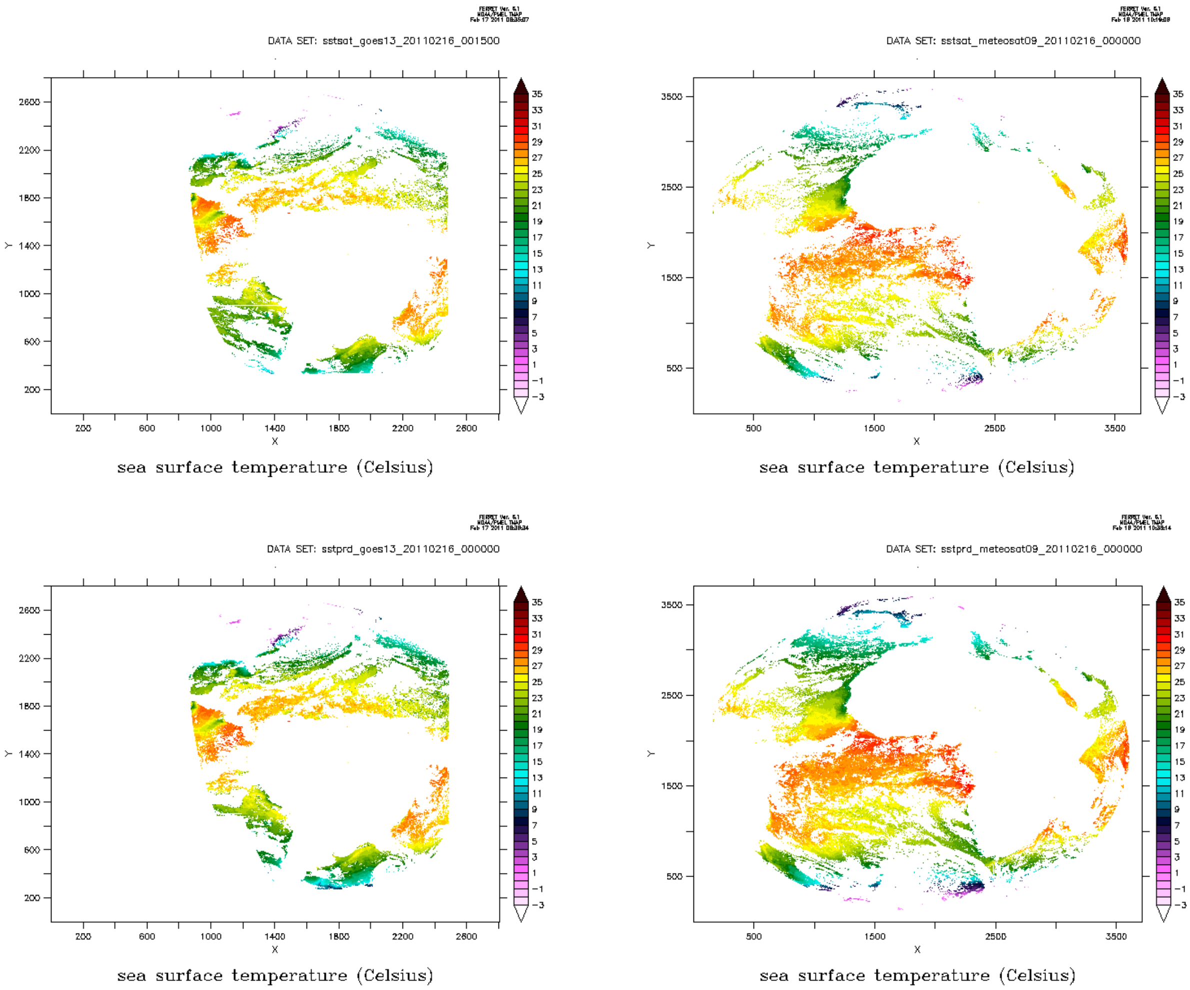
These workfiles are produced and archived at CMS for validation, control and further use.

SST fields derived from each frame are aggregated within +/- 30 minutes around a round hour to produce the hourly fields. Data are not averaged but selected at pixel level according to the following criteria (in this priority order):

- time within 30 minutes from the nominal time,
- highest quality level,
- lowest mask indicator,
- time closest to the nominal time.

One frame dated XX30 may contribute to two hourly fields, but this is not true at pixel level. Hourly fields are then remapped to the nearest neighbour on the 0.05° grid covering a 120°x 120) square centred on the satellite sub-point.

Figure 4 presents examples of full resolution frame SST, hourly collated and hourly MSG derived SST product from 60°S to 60°N and 60°W to 60°E (the SEVIRI regular grid); this figure shows also the GOES-E SST product produced by the same chain on a 0.05° grid from 60°S to 60°N and 135°W to 15°W. The present GOES-E platform (GOES-13) does not have a 12 micron channel enabling daytime SST calculations; GOES-E derived SST are restricted to nighttime conditions.



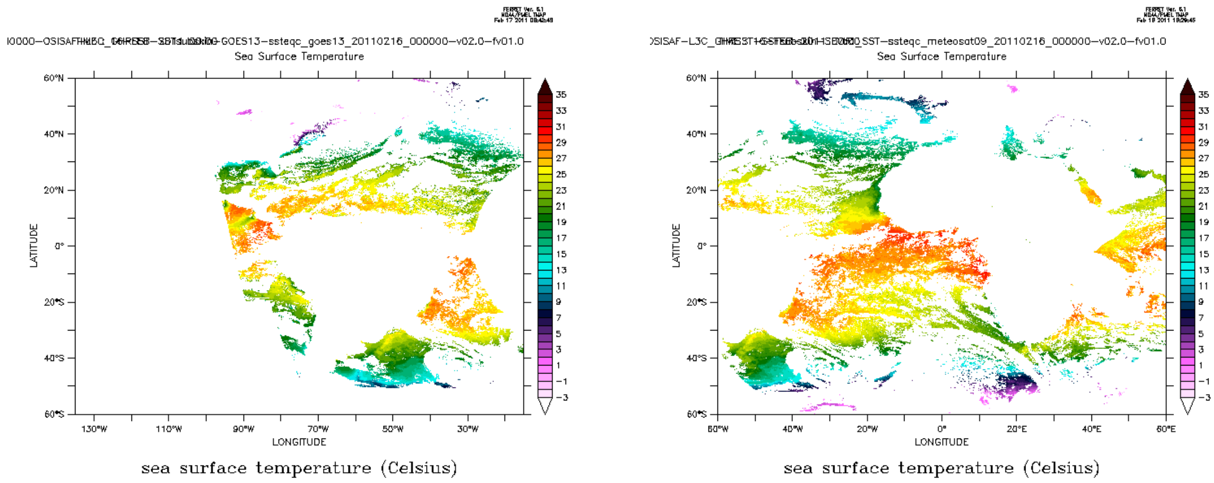


Figure 4: Geostationary chain SST products at 00:00 on the 16th of February 2011; left panels: GOES-13 (with the most western part of the area masked due to daytime conditions), right panels: MSG. Top panels: SST field derived from one frame at full resolution in satellite projection; middle panels: hourly collated files; bottom panels: hourly gridded fields.

3. Product description

The final hourly product characteristics are the following:

Projection:	linear scaling in latitude and longitude
Resolution:	0.05 degree in latitude and longitude
Size:	2400 columns, 2400 lines
Longitude and latitude limits :	GOES-E SST: 60S-60N; 135W- 15W
	MSG SST: 60S-60N; 60 W- 60E
	MSG IO SST : 60S-60N; 19.5W-101.5E

In summary the files include the following variables:

<u>Time and location information:</u>

Time, lat and lon that enable dating and locating each pixel
Or_latitude and **Or_longitude** are the original latitude and longitude values prior to remapping
L2P_flags: Flags describing the nature of the earth target

<u>Angles:</u>

Satellite_zenith_angle: The satellite zenith angle at time of observation (varies in function of the platform position)
Solar_zenith_angle: Solar zenith angle at time of observation

<u>SST information:</u>

Sea_Surface_Temperature: SST at pixel, this value contains all corrections applied throughout the processing
SSES_bias and **SSES_standard_deviation**: estimate of the error characteristics at pixel level, derived from exploiting the validation results against drifting buoys measurements.

Dt_analysis: Difference between the delivered SST and the last available SST analysis. In the nominal chain configuration, this analysis is the met. Office OSTIA analysis.
Quality_level: Quality level on a 0 to 5 scale 0: unprocessed; 1 cloudy, 2: qualitative use only: 3, 4, 5: usable data of increasing quality

Ancillary information:

Wind_speed: 10 meter wind speed derived from ECMWF forecast
Sea_ice_fraction: Fractional ice cover from OSI SAF ice concentration product
Aerosol_dynamic_indicator: Information regarding the aerosol loading of the atmosphere. In our case, it can be either the SEVIRI derived Saharan Dust Index (SDI, see section 2.2) or the NAAPS derived Aerosol Optical Depth.
Adi_dtime_from_sst: age of the aerosol information relative to the time of SST observation.
Sources_of_adi: nature of the aerosol indicator. This information is essential for using this indicator, since they are distinct in nature (and units) depending on their origin.

For more details on the content of these products, the reader is recommended to refer to the following document : GHRSST Data Processing Specification 2.0 revision 5 [RD.3].

Information on the NetCDF4 files volume (per unit) is indicated in Table 1 : Characteristics of the OSI SAF geostationary derived SST products.

4. Access to the products

The GOES-E and MSG hourly SST products are available in near-real time in L3C NetCDF format on Ifremer FTP server and via EUMETCast. L3C is the NetCDF format recommended by the Group for High Resolution Sea Surface Temperature (GHRSST).
The archived L3C NetCDF files are also available on Ifremer FTP server and in EUMETSAT Data Center (EDC).

Access to the products is indicated in the following table :

Name (reference)	Format	Near real time access	Off line access
MET SST (OSI-206) GOES-E SST (OSI-207)	L3C NetCDF	EUMETCast Ifremer FTP server	Ifremer FTP server EUMETSAT data centre (EDC)
	GRIB2* (before 12/01/2017)		Ifremer FTP server EUMETSAT data centre (EDC)
MET IO SST (demo)	L3C NetCDF	Ifremer FTP server	Ifremer FTP server

Table 5: Access to the products

Ifremer FTP server, ftp://eftp.ifremer.fr/cersat-rt/project/osi-saf/, is accessible to users registered on the OSI SAF web site http://www.osi-saf.org (Users rights are provided on request in the registration process).

5. References

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6. Appendices

6.1. L2P and L3C format description

The GHRSST data files have been chosen to follow the Climate and Forecast NetCDF conventions because these conventions provide a practical standard for storing oceanographic data. The NetCDF data format is extremely flexible, self describing and has been adopted as a de-facto standard for many operational oceanography systems. **The GDS version 2.0 products are NetCDF4 classic model files using internal compression feature**.

The table below gives an overview of the GHRSST data products specified by the version 2.0 of the GDS.

Table 6-1 GHRSST data products specified by the GDS 2.0.

<table>
<tr><th>SST Product</th><th>L2 Pre-Processed [Section 8]</th><th>L3 Uncollated [Section 1010]</th><th>L3 Collated [Section 10]</th><th>L3 Super-collated [Section 10]</th><th>Analyzed SST [Section 11]</th><th>GHRSST Multi-Product Ensemble SST [Section 12]</th></tr>
<tr><td>Acronym</td><td>L2P</td><td>L3U</td><td>L3C</td><td>L3S</td><td>L4</td><td>GMPE</td></tr>
<tr><td rowspan="2">Description</td><td rowspan="2">Geophysical variables derived from Level 1 source data at the same resolution and location as the Level 1 data, typically in a satellite projection with geographic information. These data form the fundamental basis for higher-level GHRSST products and require ancillary data and uncertainty estimates.

No adjustments to input SST have been made.</td><td>L2 data granules remapped to a space grid without combining any observations from overlapping orbits.</td><td>SST measurements combined from a single instrument into a space-time grid.

Multiple passes/scenes of data can be combined.

Adjustments may be made to input SST data.</td><td>SST measurements combined from multiple instruments into a space-time grid.

Multiple passes/scenes of data are combined.

Adjustments may be made to input SST data.</td><td rowspan="2">Data sets created from the analysis of lower level data that results in gridded, gap-free products. SST data generated from multiple sources of satellite data using optimal interpolation are an example of L4 GHRSST products</td><td rowspan="2">GMPE provides ensemble information about various L4 data products. It provides gridded, gap-free SST information as well as information about the spread in the various L4 products.</td></tr>
<tr><td colspan="3">L3 GHRSST products do not use analysis or interpolation procedures to fill gaps where no observations are available</td></tr>
<tr><td>Grid specification</td><td>Native to SST data format</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td></tr>
<tr><td>Temporal resolution</td><td>Native to SST data stream</td><td>Native to data stream</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td></tr>
<tr><td>Delivery timescale</td><td>As available, Ideally within 3 hours from acquisition at satellite</td><td>As available, Ideally within 3 hours from acquisition at satellite</td><td>As available, Ideally within 3 hours from acquisition at satellite</td><td>As available, Ideally within 3 hours from acquisition at satellite</td><td>Analyzed product processing window as defined by data provider.</td><td>As available, ideally within 24 hours of the input L4 products being available.</td></tr>
<tr><td>Target accuracy</td><td>Native to data stream</td><td>Native to data stream</td><td><0.4 K</td><td><0.4 K</td><td>< 0.4 K absolute, 0.1 K relative</td><td>< 0.4 K</td></tr>
<tr><td>Error statistics</td><td>Native to data stream if available, sensor specific error statistics otherwise</td><td>Native to data stream if available, sensor specific error statistics otherwise</td><td>Derived from input data for each output grid point.</td><td>Derived from input data for each output grid point.</td><td>Analysis error defined by data provider for each output grid point (no input data statistics are retained)</td><td>The standard deviation of the input L4 analyses is provided. This is not an error estimate, but provides some idea of uncertainty.</td></tr>
<tr><td>Coverage</td><td>Native to data stream</td><td>Native to data stream</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td><td>Defined by data provider</td></tr>
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